Role of Institutions in Urban Water Supply: A Study in Cuddalore District, Tamilnadu

V. Nagaraj

Assistant Professor
School of Maritime Management
Indian Maritime University, Cochin Campus
Bristow Road, Willingdon Island, Kochi

Abstract

This paper explores the relationship between institutions, water supply and urban regions. Rules and regulations of urban water supply institutions have adversely affected the urban water supply. The municipal authorities have no concrete policy to manage ground water and to control market based water supply sources in terms of price, quantity and quality. These facts force the poor people in the slums to depend the public water supply sources for their daily needs. Therefore, this paper suggests that the institutional changes in urban water supply by changing the regulations to get new water connection, prevention of over exploitation of ground water and control over the market based water supply sources.

Keywords:

Institutions, Water Supply, Urban Regions, Water Supply Sources.

Introduction

Urban domestic water supply is one of the fundamental factors to determine the health and sanitation. This important task is governed by the urban water supply institutions. The term institutions refer to written and unwritten rules, norms and controls that humans formulate to decrease uncertainty and control their environment (Menard & Shirley, 2008).

Further, the new institutional economics gives a new dimension and discusses the term 'institution' as institutional environment and institutional arrangement, which are complementary parts (Davis & North, 1970; North & Thomas, 1973; North, 1990). It helps to enrich the understanding of their functions. Institutional environment is defined by a set of basic written and unwritten protocols, which includes political, social and legal rules. The institutional arrangement is the governance structure. The segregation of institutional environment and institutional arrangement is not fixed but differs with the specification and level of investigation. Thus, little part of the institutional arrangements can turn out to be a part of the institutional environment and a few parts of the institutional environment can turn out to be a part of institutional arrangement (Saleth & Dinar, 2004).

In case of urban water supply, the administration of urban local body follow some standard set of rules for water supply connection, which includes authorization of town planning, type of urban limit (planned and unplanned urban limit), ownership of house and plot (own and rental) and connection deposit. In order to manage water table and ground water management, the municipality made the rain water harvesting mechanism is mandatory for the

urban households. These standard protocols are treated as the institution which governs the water supply in the urban regions.

Further, the urban water supply is satisfied by different water supply sources such as self, public and market. The self water supply include sources available within the premises of the households (own ground water sources and municipal piped water supply connection).The water supply sources availed in the common places of the streets are considered as public water supply sources such as public bore wells, public hand pumps and municipal taps. The packed water and water supplied by tankers are treated as a private water supply sources. In such scenario, this study explores the relationship between institutions, water supply and different sort of urban regions.

Application of New Institutional Economics for Analyzing Institutional Arrangements in Urban Water Supply

The institutional arrangements or governance structure is treated as an agent for institutional change. In this context, the analysis of institutional arrangement is useful to identify the requirement of institutional modification in urban water supply sector.

In urban water supply sector various combination of water supply sources are involved which include self provision (sources availed within the household premises), public (hand pump, tap and bore well availed in a common place) and market (packaged drinking water and vendor's water supply). It necessitates conducting investigation on prevailing institutional arrangements for urban water supply and improving the societal benefit.

Reaching the Millennium Development Goals in drinking water and sanitation target presents a huge challenge. It requires action to prevent current and future infrastructure falling into disrepair as a result of inadequate institutional arrangements, insufficient cost-recovery, poor operation and maintenance, and an overall lack of sound management practices. Therefore, the analysis on institutional arrangements for urban water supply is indispensable to achieve the MDG targets.

The donor agencies like World Bank have advocated the privatization of public utilities in lower-income economies to promote more efficient operation, increase investment and service coverage, and to reduce the financial burden on government budgets. Therefore, it requires examination of principles such as transparency, fairness and the creation of institutional linkages with private sector for efficient delivery of public services.

Conceptual Framework

The term institutions refer to written and unwritten rules, norms and controls. The new institutional economics discusses the term 'institution' as institutional environment (rules and norms) and institutional arrangement (Governance structure). In case of urban water supply both institutional environment and institutional arrangements are treated as institutions such as set of rules established by the local government and implementing authorities. For example: town planning authorization, type of urban limit, ownership of house and connection deposit and installation of rainwater harvesting mechanism.

Self, public and market are the major sources of water supply in the surveyed urban regions. The self water supply includes the sources availed within the household premises. The public water source

refers to the hand pump, tap and bore well availed in a common place. Market institution includes packaged drinking water and vendor's water supply. With this conceptual background, this study examines the inter-linkages between institutions, water supply and different sort of urban regions.

Review of Literature

The pioneering studies on institutional arrangements for urban water supply are mainly devoted to the urban India. The institutional arrangements are significantly differed in urban local bodies and its different locations. The studies of challenges in institutional arrangement for urban water supply reveal the important of dynamic changes in administration towards accountability, transparent and predictability (Shyam, 2000; Conners, 2005 and Govt. of India, 2012).

Similarly, Huchon and Tricot (2008) and Farrelly & Brown (2011) analyze institutional changes in water supply services and policy implementation. Analysis infers that interaction between beneficiaries and authorities improve the effectiveness of institutional changes and enhance the institutional benefits in urban water supply sector. Nagues & Thomas (2000) and Kirkpatrick et al., (2006) found that the important of utility comparison between the providers and incorporation of household characteristics from their analysis of issues of water service privatization and price negotiation between private and municipality.

Case studies of water supply services and regulatory arrangements reveal that authorities try to achieve a balance between the social and financial objectives (Gupta et al, 2006; Garlach & Richard, 2009; Esther & Richard, 2010; and Sigel, 2012). As a consequence, the studies on institutional arrangements are very clear about the realignment of institutional arrangement in urban water supply by implementing the effective institutional reforms and incorporate the concepts of accountability, transparent, balanced approach between formal and informal water utilities, homogenous pricing policy, user participation and government's role in water provision. Given this background, the present study analyses the corollary between institutions, water supply and different urban regions.

Material and Methods

Objective of the Study

i. To identify the usage of different water supply sources in different sort of urban regions.

ii. To explore the role of institutions in urban water supply among the urban regions.

iii. To examine factors influencing urban water supply other than institutional parameters.

iv. To provide suggestions to improve the urban water supply institutions.

Sampling Design

In order to analyse the water supply institutions and it determinants in urban regions, the study incorporates area sampling for district selection and disproportionate stratified random sampling for selecting the sample households.

At the first stage, Cuddalore district is selected for the following

reasons: the water supply performance of the municipalities in Cuddalore district is below the average at the state level according to the Tamil Nadu Water Supply and Drainage Board Assessment - 2009. At the same time, the urban water supply system in the Municipalities of the Cuddalore district is homogenous. That is the water supply infrastructures are established by state water supply agency and operation and maintenance are done by the concerned municipality. It is homogenous in all the municipalities of the Cuddalore district. Therefore, Cuddalore district is selected for the study. Since the district has unique institutional structure, it is apt to analyses the institutions and to suggest measures for improving the services of the same.

At the second stage, all five Municipalities (Cuddalore, Chidambaram, Virudhachalam, Panruti and Nellikuppam) of the District are selected. In the third stage, wards of the municipalities are stratified into 'slum', 'moderately developed' and 'developed regions'. The slum region is categorized according to the Slum Area Act - 1956. Areas where buildings are unfit for human habitation, overcrowding, narrowness of streets, lack of ventilation, and inadequacy in basic urban services are considered as a slum region. The expansion of residential areas located in planned and unplanned urban limits which are recently incorporated to municipal region, is considered moderately developed region. Regions emerged from the inception of municipality or regions in the central part of the urban area are considered developed region.

Method of Data Collection

In each municipality, 60 sample households are randomly selected from slum (20 households), moderately developed (20 households) and developed regions (20 households). In total, 300 households are selected for the survey by using the pre-tested and structured interview schedule. In order to avoid the bias, the data collection was completed during the normal season of 2011/12.

Research Tool

The percentage analysis and table presentation are used to explain the usage of different water supply sources in different sort of urban regions. The Multiple Linear Regression Model is adopted

to find out the role of institutions in urban water supply and other factors influencing urban water supply among the urban regions.

Limitation and Scope of the Study

The present study interlinks the institutions, urban water supply and different types of urban regions. It applies new institutional economics perspective to analyze the role of institutions in urban water supply. It will guide the urban water supply governance to understand the drawbacks in water supply policy and improve the water supply performance.

Results and Discussions

Water Supply Sources

The existing water supply sources in the surveyed regions are given in the Table 1. Based on the usage of different water supply sources, the users of water supply sources are categorized as follows: (i) public, (ii) self, (iii) public and self, (iv) public and market, (v) self and market and (vi) public, self and market.

Of the surveyed households, 23.67 % households exclusively use public system and 17.33 % rely only on self sources. At the next level, 20.33 % households use both public and self, 6 % of them rely on self and market and remaining 17 % use the combination of public, self and market water supply sources.

In the slum region, 53 % of the households solely depend on the public water supply sources followed by 30 % using both public and self water supply sources. The contributions of other sources like self (4%), public and market (5%) and public, self and market (8%) are meagre. In moderately developed region, the households are scattered in using various sources viz., public (15%), self (25%), public and self (23%), public and market (7%), self and market (12%) and public, self and market (18%). However, the contribution of self and combination of public and self is high in the moderately developed region. The households of developed region depend on self (23%), self and market (35%) and public, self and market (25%). But the contributions of other sources such as public (3%), public and self (8%) and public and market (6%) are too little.

Table 1 Water Supply Sources Used by the Urban Regions

| Sl. No. | Institutions | Urban Regions | | | Total |
		Slum (n=100)	Moderate (n=100)	Developed (n=100)	(N=300)
1.	Public	53 (53.00)	15 (15.00)	3 (3.00)	71 (23.67)
2.	Self	4 (4.00)	25 (25.00)	23 (23.00)	52 (17.33)
3.	Public and Self	30 (30.00)	23 (23.00)	8 (8.00)	61 (20.33)
4.	Public and Market	5 (5.00)	7 (7.00)	6 (6.00)	18 (6.00)
5.	Self and Market	0 (0)	12 (12.00)	35 (35.00)	47 (15.67)
6.	Public, Self and Market	8 (8.00)	18 (18.00)	25 (25.00)	51 (17.00)

Source: Computed   Note: Figures in parentheses are percentages to total sample

It explains that the sources of water supply significantly differ among the urban regions. Particularly, in the slum region, public and the combination of public and self water supply sources are dominant. In moderately developed region, the households predominantly depend on self, self and public and meagerly use other sources. But, it is widely differs in developed region. The

households of developed region mostly depend on self and the combinations of self with market and public sources. Therefore, there is a wide variation in using various sources among the urban regions.

The use of self and market sources are relatively higher in developed region. This is attributed the fact that the households in

the region are highly élite, either they are employed in Govt. institutions, classical groups or wealthy business people, who are capable of using their own provision of water supply for their consumption. Another important reason is using hygienic water supply which is an essential condition for own life style. It is also noteworthy fact that the public water sources is dominant in the slum region, it implies that the slum dwellers are covered by low class group with high poverty ridden with highly illiterate, which enables them to fetch water for consumption from the public tap provided by the municipalities.

Relationship between Institutions, Water Supply and Urban Regions

The relationship between institutions, water supply and urban regions has been analysed with the help of Multiple Linear Regression Model (MLRM). Numbers of different water supply sources, institutional, personal, and economic factors are the explanatory variables. The number of water supply sources available to the household is indicator to assess the role of institutions in urban water supply. Therefore, the availability of number of water supply sources is treated as a dependent variable, which is fitted with the explanatory factors in the following form after verifying the multi - collinearity function. Further, the households are classified as users of self sources, users of public and user of combination (user of self, public and market sources of water supply). It has been analysed by the different regions viz., slum, moderately developed and developed.

$$NWSS = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + B_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + \beta_{15} X_{15} + \mu$$

where,

NWSS = Number of Water Supply Sources (dependent variable)

Water Supply Sources

X_1 = Self water supply sources (in numbers)

X_2 = Public water supply sources (in numbers)

X_3 = Combination of water supply sources (in numbers)

Institutional Factors

X_4 = Huge Connection Deposit averts Tap Connection (Yes = 1, No = 0)

X_5 = Ownership of House (Rental = 1; Own = 2)

X_6 = Water Supply Delivery (Satisfied = 1, Dissatisfied = 0)

X_7 = Compliant Clearance (Satisfied = 1, Dissatisfied = 0)

X_8 = Infrastructure Maintenance (Satisfied = 1, Dissatisfied = 0)

Personal Factors

X_9 = Education (Illiterate = 0; Primary = 1; Middle = 2; High = 3; H.Sec. = 4; College = 5)

X_{10} = Occupation (Wage = 1; Business = 2; Private = 3; Govt. = 4; Others = 5)

X_{11} = Total Family Members (in numbers.)

Economic Factors

X_{12} = Annual household Income (Actual income)

X_{13} = Number of Earners (in numbers)

X_{14} = Asset (Actual value)

X_{15} = Housing Area (Actual Area in sq. feet)

μ = random error, which are normal, independent with the mean '0' and variance 'σ^2'.

In the model, the estimated coefficients (βs) provide the marginal effects of the respective explanatory variable on number of water supply sources in the study regions. The adjusted coefficient of multiple determinations ($\overline{R}^2$) examines the contribution of explanatory factors on endogenous factor on a number of water supply sources. The suitability of the fitted Multiple Linear Regression Model is tested by using 'F' test. In addition to this, the influence of each explanatory factor on endogenous factor on the number of water supply sources is tested by students''t' test.

Table 2 Institutions, Water Supply and Urban Regions: Multiple Linear Regression Model

Sl. No.	Predictor Variable	Estimated Marginal Effect (β Value)			
		Urban Regions			Pooled
		Slum	Moderate	Developed	
A	Number of water supply sources				
1.	Self water supply source (No.)	0.33 * (9.15)	0.77 * (18.63)	0.63 * (8.31)	0.62 * (18.59)
2.	Public water supply sources (No.)	1.10 * (22.06)	0.72 * (20.96)	0.34 * (8.46)	0.80 * (22.63)
3.	Combination of water supply sources (No.)	1.51 * (35.09)	1.43 * (31.73)	1.41 * (17.47)	1.57 * (39.34)
B	Institutional factors				
4.	Huge connection deposit lack the tap connection (score)	-0.06 * (-2.01)	-0.06 * (-2.41)	-0.08 * (-1.95)	-0.07 * (-1.79)
5.	Ownership (score)	-0.01 (-0.26)	-0.05 (-1.80)	-0.14 * (-4.26)	-0.06 * (-3.35)
6.	Water supply delivery (score)	0.02 (0.63)	0.10 * (3.83)	0.15 * (2.40)	0.04 * (2.01)
7.	Compliant clearance (score)	0.09 * (2.52)	-0.02 (-0.67)	-0.13 * (-2.14)	0.02 (0.92)
8.	Infrastructure maintenance (score)	0.00 (-0.06)	0.01 (0.40)	0.05 (1.37)	0.02 (0.94)
C	Personal factors				
9.	Education (score)	0.03 (1.12)	-0.02 (-0.77)	0.02 (0.47)	0.00 (0.17)

10.	Occupation (score)	-0.07 * (-1.93)	-0.05 * (-2.73)	-0.09 * (-2.26)	-0.04 * (-1.95)
11.	Total family members (No.)	-0.07 (-1.87)	0.00 (0.05)	0.03 (0.52)	-0.02 (-0.84)
D	**Economic factors**				
12.	Annual income (actual)	-0.01 (-0.22)	0.06 (1.30)	0.10 (1.83)	0.03 (1.24)
13.	Earners (No.)	0.00 (0.07)	-0.02 (-0.41)	-0.15 * (-2.23)	-0.02 (-0.70)
14.	Asset (actual)	0.00 (-0.08)	-0.09 * (-2.15)	-0.02 * (-2.48)	-0.02 * (-2.79)
15.	Housing area (actual)	0.04 (0.92)	-0.04 (-1.11)	-0.07 (1.68)	0.00 (-0.15)
	Adjusted R^2	0.94 *	0.95 *	0.91 *	0.90 *
	F- value	94.39	117.39	73.41	189.69

Source: Computed   Note: Figures in parentheses are t statistic, * significant at 5 per cent level

The result of the Multiple Linear Regression Model is given in Table 2. The estimated factors of the Multiple Linear Regression Model for 100 households in each regions viz. slum, moderately developed and developed regions, provide the expected average change in number of water supply sources to the households with respect to each of the predictor factors.

The coefficient of multiple determinations ($\overline{R}^2$) of slum (0.94), moderately developed (0.95), developed (0.91) and pooled region (0.90) are statistically significant at 5 per cent level. It implies that the availability of number of water supply sources is determined by around 95 per cent of the factors in the present analysis. The remaining 5 per cent is determined by the 'other explanatory factors' which are not included in the present analysis. The suitability of the model through 'F' test exhibits the values of 94.39, 117.39, 73.41 and 189.69 in slum, moderately developed, developed and in the overall study regions, respectively. All the 'F' values are found to be statistically significant, thereby indicates the suitability of the model for the analysis.

The results of the pooled data analysis infer that the self water supply sources, public water supply sources and water supply sources from various combinations are found to be positively significant. Among the sources, various combinations (39.34) avail more water supply sources to households as compared to the public (22.63) and self (18.59). Thus, users avail more number of sources from the combination of various water supply sources. The same trend could be noticed in all the surveyed regions. i.e. slum, moderately developed and developed. At the same time, the influence of public water supply sources is relatively high in slum region as compared to other regions.

According to the municipal water supply regulations, the households reside in planned urban limit receive the municipal water supply connection in a simple way while it is a difficult task for the households in unplanned urban limits viz., residents in slum and *purampoku* land *(government land or common land)*. In addition, the slum households avert to own self taps due to huge amounts for connection deposit and connection charges. Further, the municipality fails to have regulations about the ground water extraction. It leads the overexploitation of ground water and requires deep bore hand pumps and deep wells. But the poor economic status of the slum households prevents in extracting ground water sources like hand pumps and bore wells. On the other hand, the municipal authorities unable to regularize the packaged water supply in terms of quality, quantity and price. The private water supply don not affordable for the slum household of the study regions. As a result, the slum households highly depended on public sources as compared to others.

Complaint clearance has positively influenced the availability of number of water supply sources in the slum region. That is, effective compliant clearance solves damages and leakages in water supply, which influences number of water sources. Whereas, the connection deposit (-2.01) has negatively affected the availability of tap connection in the slum region. This infers inverse relationship between availability of tap connection and connection deposit in the slum households. Thus, huge deposit for receiving tap connection has restricted the slum households to avail piped water supply service.

On the other hand, occupation (-1.95), house ownership (-3.35) and asset (-2.79) are found to be negatively significant in the pooled data analysis. Occupational status of the surveyed households has negatively influenced the availability of number of water supply sources. That is, household's income from govt. service, private and business likely reduces the availability of number of water supply sources as they own self water supply sources within the premises. Likewise, household asset and house ownership reduce the number of water supply sources availed by the households. Thus, strong economic background helps to own self water supply sources and reduces multiple sources. In slum region, the self water supply sources (9.15), public water supply sources (22.06), water supply sources from various combination of institutions (35.09) and complaint clearance (2.52) are found to be positively significant on availability of number of water supply sources. Among the sources, combinations of various water supply sources positively influence the number of water supply sources in the slum regions, followed by public and self institutions.

The contribution of self water supply sources (18.63), public water supply sources (20.96), water supply sources from various combinations (31.73) and water supply delivery (3.83) positively influences the availability of number of water supply sources in the moderately developed region. On the contrary, occupation (-2.73), total asset value (-2.15) and huge connection deposit (-2.41) negatively affect the availability of number of water supply sources in the moderately developed region. As aforementioned, better occupational status and high asset value affect the number of water supply sources since they own self water supply sources within the premises.

In the case of developed region, the self water supply sources (8.31), public water supply sources (8.46), combination of various water supply sources (17.47) and water supply service delivery

(2.40) are found to be positively significant and influence the number of water supply sources. At the same time, occupation (-2.26), house ownership (-4.26) number of earners (-2.23) and total asset (-0.48), compliant clearance (-2.14) and huge connection deposit for tap connection (-1.95) negatively affect the availability of number of water supply sources in the developed region. The positive influence of occupation, house ownership, number of earners, total asset, compliant clearance and huge connection deposit reduces the availability of number of water supply sources. Thus, economic status of the households facilitates to own self water supply and reduces the use of multiple sources.

Conclusion

Different sort of conclusions could be drawn from these results and discussions of the relationship between institutions, water supply and urban regions. But the researcher would like to assert here on three points. First, urban water supply institutions such as rules and regulations for getting water connection is adversely affect the urban water supply in the study area. In particular, this rules and regulations differentiated the urban regions to access the urban water supply sources. Receiving municipal water supply connection is simple process for the households of planned urban limit but it is a hard for the households in unplanned urban limits viz., residents in slum and *purampoku* land *(government land or common land)*. In addition, the slum households avert to own self taps due to huge amounts for connection deposit and connection charges. These factors force them to utilize the public water supply sources and search different sources of water supply for their daily needs.

Second, municipalities of the study area were framed a rain water harvesting policy for managing the ground water resources. However, their policies are failed to prevent the over exploitation of ground water. It forces the households to use the deep bore wells and deep hand pumps. But it is not affordable for the economically backwards and slum households. As a result, the slum households highly depended on public sources as compared to others. Third, the municipal authorities do not have a policy to control market based water supply sources such as packaged drinking water supply, water vendors and tankers in terms of price, quantity and quality.

Thus, the municipalities mandatory to reframe their water supply institutions. They required relax and revamp the standard protocols for getting urban water supply connection. In addition, the municipalities are indispensable to formulate policies against the over exploitation of ground water and control over the market based water supply sources.

References

Connors, G. (2005). When utilities muddle through: pro-poor governance in Bangalore's public water sector. Environment and Urbanization, 1, 201 - 17.

Davis, L E., & North, D C. (1970). Institutional change and American economic growth: a first step towards a theory of institutional innovation. Journal of Economic History, 30 (1), 131 - 49.

Dutta, S.S. (2000). Partnerships in urban development: a review of Ahmedabad's experience. Environment & Urbanization, 12 (1), 13 -26.

Esther & Richard. (2009). Regulating Water Services for the Poor: The Case of Amman. Geoforum, 40, 431 - 41.

Esther & Richard. (2010). Regulating Water Services for All in Developing Economies. World Development, 20 (9), 1229 - 40.

Farrelly, M., & Brown, R. (2011). Rethinking urban water management: Experimentation as a way forward?. Global Environment Change, 21, 721 - 32.

Govt. of India. (2012). Advisory Note: Improving Urban Water Supply and Sanitation Services. Ministry of Urban Development, Delhi.

Gupta, S., Kumar, S., & Sarangi, G K. (2006). Measuring the performance of water service providers in urban India: implications for managing water utilities. National Institute of Urban Affairs Working Paper, No. 06. New Delhi.

Huchon, A., & Tricot, G. (2008). Between citizens and institutions: the dynamics of the integration of water supply and sanitation services in Hyderabad. Centre for Social Sciences and Humanities Occasional Paper, No. 22, New Delhi.

Kirkpatrick, Colin, David, Parker, & Yin-Fang Zhang. (2006). State versus private sector provision of water services in Africa: an empirical analysis. The World Bank Economic Review, 20 (1), 143 - 52.

Menard & Sherley. (2008). Handbook of new institutional economics. Verlag Berlin Heidelberg, Germany: Springer.

Nauges & Thomas. (2000). Privately operated water utilities, municipal price negotiation, and estimation of residential water demand: the case of France. Land Economics, 76 (1), 68 - 85.

North & Thomas. (1973). The rise of the western world: a new economic history. Cambridge: Cambridge University Press.

North. (1990). Institutions, institutional change and economic performance. Cambridge: Cambridge University Press.

Saleth & Dinar. (2004). The institutional economics of water: a cross-country analysis of institutions and performance. Cheltenham: Edward Elgar.

Sigel. (2012). Urban water supply and sanitation in mongola: a discretion of the political, legal and institutional framework. UFZ, Working paper, 01/2012.

Tamil Nadu Water Supply and Drainage Board. (2009). Urban water supply performance in Tamil Nadu. TWAD Board, Chennai, Tamil Nadu.